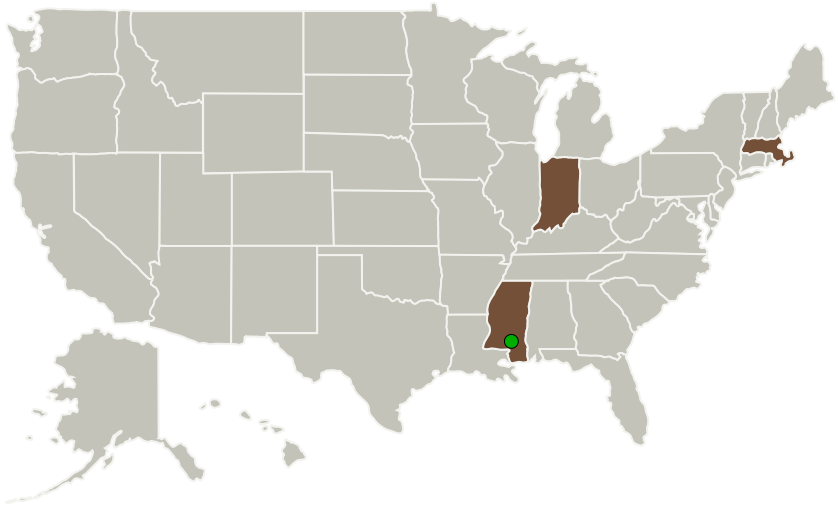
Electrical Power from Thermal Energy Scavenging in High Temperature Environments, Phase I

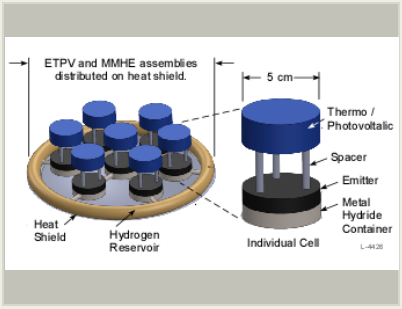
Completed Technology Project (2017 - 2018)

Project Introduction

Physical Sciences Inc. and Purdue University propose to develop a novel approach to scavenging heat from high intensity thermal environments encountered during space missions and converting this thermal power to electrical power at high efficiency. Examples include extremely hot heat shields during vehicle entry into planetary atmospheres (Mars/Venus probes) and during high speed ascent through planetary atmospheres (Sample return from Mars/Venus), hot claddings of radioisotope thermoelectric generators used for powering outer planetary spacecraft and multi-decade planetary bases (Mars/Venus/Lunar), as well as combustors and nozzles of space and launch propulsion systems. In this STTR we will develop an integrated metal hydride system and spectrally-tuned thermophotovoltaic power converter system that can extract heat during periods of high thermal intensity (tens of seconds), and convert it to electricity at greater than 25 percent efficiency. Following the end of this period, the system can continue to generate useful power for additional tens of minutes. In Phase I, for the power converter system, we will demonstrate feasibility of fabricating a critical component in larger areas (5 cm x 5 cm), and for the metal hydride (MH) system, we will experimentally characterize the MH decomposition/recombination reactions that enable continual electrical power generation for a useful duration after the period of high thermal intensity has ended. In Phase II, we will produce an engineering prototype of the integrated heat scavenging electrical power generator system, fully tested in laboratory environment and in simulated operational thermal environment, together with an analytical model of a functional system.

Primary U.S. Work Locations and Key Partners





Electrical Power from Thermal Energy Scavenging in High Temperature Environments, Phase I Briefing Chart Image

Table of Contents

Electrical Power from Thermal Energy Scavenging in High Temperature Environments, Phase I

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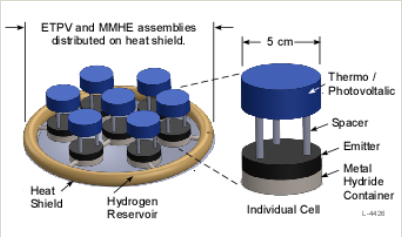
Organizations Performing Work	Role	Type	Location
Physical Sciences, Inc.	Lead Organization	Industry	Andover, Massachusetts
Purdue University-Main Campus	Supporting Organization	Academia	West Lafayette, Indiana
Stennis Space Center(SSC)	Supporting Organization	NASA Center	Stennis Space Center, Mississippi

Primary U.S. Work Locations	
Indiana	Massachusetts
Mississippi	

Images



Briefing Chart Image
Electrical Power from Thermal Energy Scavenging in High Temperature Environments, Phase I Briefing Chart Image *(https://techport.nasa.gov/image/136412)*

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Organization:
Physical Sciences, Inc.

Responsible Program:
Small Business Innovation Research/Small Business Tech Transfer

Project Management

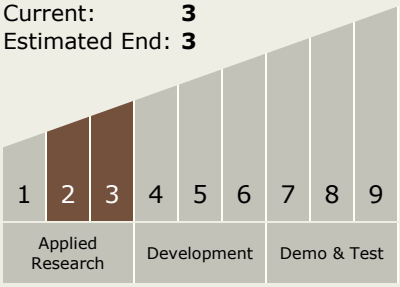
Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
Prakash B Joshi

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



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Completed Technology Project (2017 - 2018)

Technology Areas

Primary:

- TX03 Aerospace Power and Energy Storage
  - TX03.1 Power Generation and Energy Conversion
    - TX03.1.4 Dynamic Energy Conversion

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System